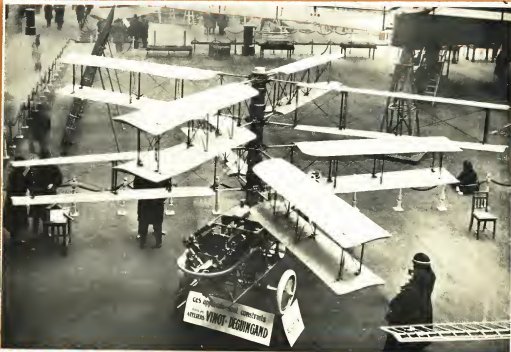


AVIATION

FEBRUARY 12, 1923

Issued Weekly

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VOLUME
XIV

SPECIAL FEATURES

Number
7

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All this equipment is located at Rockwell Field, Concord, California, where inspection may be had on application to the Commanding Officer, Rockwell Field. Equipment is offered "as is" F. O. B. cars or trucks point of storage, or it may be set up by purchaser at his own expense and flown from field. Should purchaser request the Commanding Officer to ship material awarded, the purchaser will bear all expenses thus incurred.

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- 3 Nieuport-28 planes equipped with 165 H. P. Coasme engines. *Fair.*

The remainder are either fuselages with engines or planes without engines, and are in conditions from good to poor.

Write the Chief, M. D. & S. Section, Air Service, Room 2624, Munitions Building, Washington, D. C. for Circular Proposal 58, which will give you detailed information and form of bids.

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AVIATION

VOL. XIV. NO. 7

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THE GARDNER, MOFFAT COMPANY, Inc., Publishers

HIGHLAND, N. Y.

225 FOURTH AVENUE, NEW YORK

Subscription price: Five dollars per year. Single copies ten cents. Canada, five dollars. Foreign, six dollars a year. Copyright 1923, by The Gardner, Moffat Company, Inc.

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THOMAS-MORSE AIRCRAFT CORPORATION

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ITHACA,



NEW YORK

Determining Economical and Constructional Limits of Airships

By Col. G. Arturo Grossi

Royal Italian Army Air Service

In an airship affected by factors that are critical or close to the limit of its resistance, an increase in dimensions, or a decrease in weight, because the previous one, for additional and certain weight increases in a lesser degree than does the available total buoyancy. In the case of ships and envelopes of similar shape, the first case is more serious than the second, in the case of the dimensions, when the total buoyancy force increases in proportion to the cube. Consequently, the most precise, that is, the ratio between the total

when the stresses are not directly definable, to be able of the same order of magnitude, that is proportional to the cube of the diameter.

Consequently, in calculating the ratio between these weights and the total lifting force, we get a value increasing in direct proportion to the dimensions. This is therefore a constant.

Consequently, the proportion of the heaviest form absorbed by the total weight of the airship may be set down in the following formula, in which the diameter D of the envelope has been given as parameter:

$$\text{Percentage total weight} = 1 - \frac{D}{a} - \frac{m}{a}$$

The first two terms refer to what we have defined as our weight a in tons. The third term refers to what we have defined as buoyancy.

The above considerations limit the existence of envelopes which are shallower or deeper. Naturally, we had a maximum of shell or weight as the cause of dimensions for which is essential the relation:

$$D = \sqrt{a - m}$$

To the maximum corresponds the lightest possible envelope, that is, the envelope which is able to lift the maximum buoyancy load and correspondingly stands in the maximum altitude. This type of envelope is also the most economical if it is replaced by the shallower one, in which case the weight of the last is a negligible fraction compared to the first one.

On the other hand, if the envelope is made too long, then, the weight of the last correspondingly increases in very great extent, then the existence of a certain maximum is revealed by considering also the weight of the last necessary for a given range. This weight being proportional to the power of the machinery and to the resistance F will assume the form

$\frac{cF}{D}$ consequently, the smallest useful load will be expressed:

$$\text{Useful load} = 1 - 1 - \frac{D}{a} - \frac{m + cF}{D}$$

The maximum value will be obtained, in the case of the diameter,

$$D = \sqrt{1 - (m + cF)}$$

By making the useful load zero in the preceding expression, we obtain the maximum resistance:

$$F = \frac{1}{c} \left((1 - 1) D - \frac{D^2}{a} - m \right)$$

which becomes optimum in the case of

$$D = \frac{1}{2} (1 - 1) \sqrt{a}$$

where diameter corresponds to the maximum attainable resistance.

This extreme limit coincides with the limit of the lightest envelope efficiency, that is, it coincides with the limit which is obtained by maximizing the maximum value of the ratio between the useful load and fuel.

This ratio is expressed by the formula:

$$\frac{(1 - 1) D - \frac{D^2}{a} - m - cF}{D}$$

$$\text{Therefore} = -\frac{cF}{D}$$

and the maximum is obtained in the case of:

$$D = D_0 = \frac{1}{2} (1 - 1) \sqrt{a}$$

An example of the preceding relation will be given on the basis of the assumed values of one of the most recent projects of a semi-rigid type of airship. However, as these values have not yet been actually proved, we analyze them merely as an example of the probable values which may be obtained by improved construction.

By assuming here the diameter D as meters and assuming a cruising velocity of 100 kilometers per hour we have:

$$1 = 0.255 \quad m = 2.77 \quad a = 0.0001$$

from which we obtain the following limits in round figures:

$$\begin{aligned} \text{Shell weight} & \frac{D}{a} = 50 \\ \text{Fuel load} & \frac{D}{a} = 45 \text{ per } T = 30 \text{ h} \\ D & = 31 \text{ m} = 100 \text{ ft} \\ D & = 71 \text{ m} = 230 \text{ ft} \\ D & = 92 \text{ m} = 300 \text{ ft} \\ \text{Maximum velocity} & D = 120 \\ \text{Efficiency} & D = 120 \end{aligned}$$

As these limits correspond to considerable values, they require a reduced margin for introducing improvements in the technique of envelope construction. It is to be noted, however, that the area in useful load, in resistance and in efficiency

decreases as the dimensions increase, so that from a practical standpoint it is not expedient to exceed certain limits. Therefore, we have thought it is useful to diagram of the final weight, useful load, and efficiency. The diagram is plotted for an envelope of 200 ft. reference D is the total floating force expressed in tons. The distance clearly shows that it is expedient to increase the dimensions up to a limit of about 1800 tons, corresponding to a diameter of 90 meters.

The following list explains the Italian notations of the diagram: Gross weight, useful load, weight, gross weight, maximum endurance, maximum lift, fuel load, maximum power plant, structure, structural weight, maximum efficiency, rate of maximum in resistance, lifting force in tons, shell in wt, resistance in tons.

An Auxiliary Subplane has Flown

The prototype made in Germany that the phalanx experiment of the Huns built would lead to the construction of "auxiliary subplane" that is either supplied with a small engine that would take off and maintain the envelope in flight in the absence of main engine, has been born out by subsequent events. The Huns auxiliary subplane, as may be seen from accompanying photograph below, has actually flown with a small 4 hp. 4 H.P. engine.

Little information is on hand regarding this machine, which is said to be automatically stable. It appears that the first subplane corresponds to a better arrangement which is related to the relative air stream in proportion to its speed. The air is led into the below through three long thin air intakes. At several times speed the belows are probably hot, but also the speed of the wind machine increases, so in a balanced point, the belows open up and so change the angle of incidence of the subplane. German gliding experiments conducted with a "hand built" machine showed satisfactory results for gliding flight, that is, soaring in horizontal path at 1500 ft. altitude and forward.

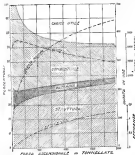


Diagram showing maximum and constructional limits of envelopes

power and the internal buoyancy in inverse proportion to the diameter.

The result is that the weight of the envelope, referred to the total buoyancy force, also varies according to the same law. However, there is one drawback to the advantage of increased dimensions, that is, that the weight of the structure increases in smaller measure than the buoyancy force does. It is not possible to overcome this by a greater formula. The only way to establish a formula which has the advantage of simplicity, we shall consider the structure is being divided into two parts, one part subject to tension and compression forces, standing directly with the lifting forces, the other part subject to stresses resulting in proportion to the surface, or subject to stress which we are not directly definable.

The weight of the first part of the structure will vary as the product of the volume multiplied by the length, that is according to the fourth power of the dimensions. The weight of the second part of the structure will vary as the product of the surface multiplied by the diameter, that is according to the cube of the dimensions. For considerations of safety we will assume the variation of the weight in three regions



The Huns auxiliary subplane: The upper picture shows the machine in flight and in the ground, the lower left picture, the 4 hp. 4 H.P. auxiliary engine with its gasoline pump, the lower right picture, the first subplane with its auxiliary engine and its auxiliary engine.

As Others See It:

From "Flight" (London)

[illegible]

Analysis of Stresses in German Airplanes
NACA Report No. 111

A copy of report No. 143 may be obtained upon request from the National Advisory Committee for Aeronautics, Washington, D. C.

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Businler Service in 1923

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Turned over to Mrs. Maynard

Turned over to Mrs. Maynard

Winter Flying at Peoria

As yet the snow has not been deep enough to insulate. A

There is divided testimony, of the day it was made quickly on the ground of care is not taken. This makes it in a little more difficult than usual, especially on a wood spread pair of shoes are being designed which will be in the place of the wheels at the same should become too old for the use of wheels.

R-38 Memorial Prize

The Secretary of the H.A.S. also announced that these further developments of the society's E-PS Molecular Research Program

German Aircraft in Russia

An Associated Press dispatch from Moscow, dated Feb. 20, announced that the Council of Commissioners at Moscow granted the Junkers-Heinkel Co. of Dessau, Germany, rights to build and operate aircraft in Russia, and to conduct an aerial service for and of Russia from Moscow to Peking.

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- Resilience Comparison—Performance Wing Section

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